A CONCISE GUIDE TO EFFECTIVE MANAGEMENT OF THE PUBLIC WORKS EQUIPMENT FLEET

BY

VICENTE DE ARMAS

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A REPORT PRESENTED TO THE GRADUATE COMMITTEE OF THE DEPARTMENT OF CIVIL ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING

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I would like to express my gratitude to the Alachua County Public Works Department's Office of Fleet Management and the Physical Plant Division of the University of Florida for taking time off their busy schedules to assist me in this study.

ABSTRACT

The purpose of this report is to present in a concise form the principles and fundamentals of managing the public works equipment fleet, providing a basis from which to develop an effective fleet management program.

The report begins with a review of today's trends in fleet management, including, organization, privatization, effects of environmental regulations and a discussion on information management systems. Subsequent chapters discuss the basic fleet management functions such as equipment ownership, utilization, maintenance, financing of equipment services, and the implementation of an effective fleet management information system. The next to last chapter is a cursory review of the Alachua County and the University of Florida public works equipment management organizations. The purpose of this review is to compare these organizations to the trends, principles and fundamentals discussed in this report in an attempt to support the fundamentals here presented.

An effective fleet management program will guide the organization through the process of determining the major objectives of the fleet operation, defining the strategies that will govern the acquisition and utilization of the resources to achieve these objectives. Effective fleet management is essential to the success of a public works organization.

PROBLEM STATEMENT

Although much has been written about the various aspects of equipment management, there is an apparent lack of a comprehensive guide concerned with the overall subject of public works equipment management.

OBJECTIVE

The objective of this report is to put together in a concise form, useful information that will give an inexperience public works manager a better understanding of the principles and fundamentals of fleet management, therefore, facilitating the development of a successful fleet management program.

LITERATURE SEARCH

The material here presented was collected from a variety of sources. These sources included: an extensive library search; three interviews and two site visits to the Alachua County Office of Fleet Management, and the University of Florida Motor Pool Office and Work Management Center. For detailed information on sources employed, please go to the references section on page 56 of this report.

TABLE OF CONTENT

Acknowledgment i
Abstract ii
Problem statement iii
Objective iii
Literature search iii

Chapter one - Introduction 1

1.1 What is Fleet Management? 1
1.2 Managing the Public Works Equipment Fleet in the 1990s 1
1.3 Fleet Management Organization 2
1.4 Privatization 3
1.5 Competition Budgeting 5
1.6 Effects of Environmental Regulations on Fleet Management 6

1.6.1 Alternative Fuel Vehicles 7

1.7 Information Management System 9

Chapter Two - Fleet Management Functions 11

2.1 Equipment Ownership 11

2.1.1 Owned Equipment 11
2.1.2 Rented or Leased Equipment 14
2.1.3 Equipment Replacement 16

2.1.3.1 The Annual Cost Analysis 17
2.1.3.2 The Nomogram Approach 18
2.1.3.3 The Point Rating System 19

2.2 Equipment Utilization 20

2.2.1 Assignment of Equipment 20
2.2.2 Utilization Balancing 21
2.2.3 Operator's Training and Responsibility 21

2.3 Maintenance of Equipment 22

2.3.1 Equipment Servicing 22
2.3.2 Preventive Maintenance 24

2.4 Financing Equipment Services and Cost Control 26

Chapter Three - Fleet Management Information Systems.....28

3.1 Fleet Management Information Systems.....28
3.2 Implementing a Fleet Management Information System.....31

Chapter Four - A Cursory Review of the Alachua County and The University of Florida Motor Vehicle Fleet Management.....35

4.1 The Alachua County Office of Fleet Management.....35
4.2 Public Works Equipment Management at the University of Florida.....38
4.3 Observations.....40

Chapter Five -Conclusions and Recommendations.....41

5.1 Conclusions.....41
5.2 Recommendations.....42

Appendix A - Policy Guide For Major Equipment Purchase and Replacement.....44

Appendix B - Summary of Information Management Requirements For Any Equipment Management System.....47

Appendix C - Examples of Analyses.....49

Appendix D - Specification Summary: Physical Plant Division's electric truck.....54

Appendix E - Electric Vehicle Operation and Maintenance Cost Summary.....55

References.....56

LIST OF FIGURES

Figure 1..... 9

Figure 2..... 17

Figure 3..... 19

Figure 4..... 38

Figure 5..... 40

CHAPTER ONE

INTRODUCTION

1.1 What is Fleet Management?

Fleet management encompasses a variety of functions including the ownership, replacement, utilization and maintenance of public works equipment. The objective of fleet management is to provide effective and dependable equipment that is properly designed to furnish the necessary service. The basic job of the fleet manager is to develop a program that will provide the maximum amount of service output for the minimum amount of money input (1:191).

Fleet management guides the organization through the process of determining the major objectives of the fleet operation, and defines the strategies that will govern the acquisition and utilization of the resources to achieve these objectives.

1.2 Managing the Public Works Equipment Fleet in 1990s

Fleet management, just as public works in general, has moved from the simple techniques and procedures to the planning, analysis, measurements and evaluation of complex operations with a significant increase in the application of automated systems, and a higher concern with human relations, legal repercussions, politics and education. The management job is much broader than it was in earlier decades (2:18). There has been a shift from a maintenance to a management mentality, from asking "How do we keep the trucks running?" to " How do we do it at the lowest cost?" (3:49).

Two very important requisites of today's fleet managers are the ability to work with elected officials, and higher education. As a top administrator in the public works

organization, the fleet manager must relate effectively with the city administrator, mayor or governing bodies. They constitute the fabric of today's complex urban structure, and a positive relationship is critical to the success of the fleet operations. Second, with the broader spectrum and increased performance requirements placed upon the manager, today's educational demands in public professions are much higher. Specific reasons include:

- Technological progress,
- Increased environmental awareness,
- Growth of data and information management systems,
- The advent of sophisticated motor vehicles,
- The advent of sophisticated maintenance equipment,
- The requirement for emergency planning and preparedness, and
- A much greater responsibility for dealing with people, groups and organizations.

As result, the manager finds itself in a highly competitive environment where he or she can no longer afford to be reactive. It is neither effective nor cost-efficient. The manager must be proactive; capable of efficiently planning, organizing, controlling and manipulating the resources and expenditures of the organization.

1.3 Fleet Management Organization

The fleet management organization is a function of the size and overall management structure of the public agency. During the 1980s there was a strong

movements towards centralized management of the equipment fleet. The management responsibilities were taken from each individual governmental agency and assigned to one office, normally the public works department. Centralization allowed for better prioritization of vehicle replacement and maintenance operations, extending the service life of the equipment, reducing the operational cost, and providing the manager with the flexibility to adjust to changes in this dynamic field (1:190).

In the 1990s, spurred by deregulation and competition, the entrepreneurial spirit entered into the public works fleet management field bringing significant changes to the organization.(3:49). Among the most significant changes were:

- Increasing responsibility and accountability at lower level of the organization,
- Decentralizing the decision making process,
- Changing from a data gathering process to an information management system,
- A need for higher skill level, and,
- Privatization.

The organization had to operate more like the private sector, conscious of what it costs to do business and driving those costs down.

1.4 Privatization

For many public managers privatization has come to mean an indictment of their ability to do the job. Many public managers become defensive when approached with the alternative of privatizing sectors of their operation. However, fleet managers must not overlook the fact that there are valuable opportunities to improve performance and reduce costs by taking advantages of certain private sector services. Some of the

reasons why the private sector can manage these services better and/or cheaper than the public sector are most frequently associated with one of the following (4:38):

- Higher wages attract higher skill-level personnel,
- Government employee recruitment policies frequently make it difficult to replace employees in high turnover jobs in a timely manner,
- Low government wages do not encourage permanency, many times becoming a training ground for the private industry,
- Competition from the private industry for particular skills is too high hindering recruitment,
- Government policy does not allow for procurement of certain types of specialized equipment, and,
- Limited employee advancement and promotion opportunities because of budgetary constraints.

An example of a successful partial privatization is the City of Clearwater, Florida, who after experiencing excessive equipment downtime caused by delays in obtaining repair parts, created a contractor operated parts store (4:39). The contractor was responsible for acquiring, receiving, stocking, and issuing equipment repair parts and supplies for fleet maintenance. Savings were estimated at nearly $60,000 for the first year of operation in 1978 and over $350,000 in fiscal year 1991. Privatizing the parts store resulted in:

- A more effective and productive use of the mechanic's time,
- No interest cost for shelf stock,

- No losses from carrying obsolete shelf stock,
- Reduced operating expenses from air freight and other emergency procurement costs, and,
- The elimination of the expense of a parts chasing vehicle.

1.5 Competition Budgeting

The concept of competition budgeting emphasizes the importance of understanding financial information in managing the fleet. It establishes a private like financial structure, replacing the profit centers with cost centers. The process allows managers to understand the relationship between cost and revenue by forcing them to analyze each and every service delivered by the organization, comparing it to the their counterpart in the private industry and having to justify all non-competitive costs. Competition budgeting require the following:

- Determining the cost centers. These are specific areas for which to deliver a specific service and have a specific revenue stream.
- Justifying non-competitiveness. Understanding that if a specific service is not justifiable, it should not be performed. And,
- Developing a fully burdened labor rate. This is how the organization will recover all of its operating expenses. Therefore, it is important to include administrative wages and mechanics' wages including fringes, and operating costs including utilities, supplies, tools, purchasing fees and data processing.

Competition Budgeting is also an excellent management tool as it increases the working knowledge of the organization, develops a better understanding of the

customer's needs and rights, decentralizes decision making and keeps the organization's personnel better informed (5:16).

As an example, the public works department of Broward County, Fort Lauderdale, Florida successfully implemented this concepts, and for the last three consecutive fiscal years they have reduced their operating budget, the fleet has grown at six percent annually, and were able to reduce their administrative staff (5:15).

1.6 Effects of Environmental Regulations on Fleet Management

Environmental issues have changed the way fleet administrators operate as the government and general public becomes more concerned with the impact on the environment and the potential threat to human health by the unregulated operation and maintenance of motor vehicles (6:22). Environmental regulations of most concern to the fleet managers are:

- Resource Conservation and Recovery Act of 1976,
- Hazardous and Solid Waste Amendments of 1984,
- Alternative Fuel Vehicle Regulations issued under the National Energy Policy Act in 1992,
- Clean Air Act Amendment of 1990, and,
- Clean Water Act.

Following are some of the things managers may have to do to bring their operation to compliance with the environmental regulations:

- Establishing total accountability for all hazardous waste generated from the fleet operation and maintenance. As generators, they are accountable from cradle to grave or from generation to disposal.
- Establishing a waste stream recovery program. Particularly the handling and disposal of lead-containing batteries and reclaimed waste oil.
- Complying with RCRA's requirements for underground storage tanks, specifically, secondary containment and ground water monitoring.
- Installing a new or modifying the existing storm water collection system to comply with RCRA's requirements for containment of no-point source contamination. The collection system must be capable of separating oils and other hazardous waste from the storm water prior to discharge into the city storm sewer.
- Establishing a Vehicle Emission Testing program as set forth in the Clean Air Act.
- Converting to an alternative fuel vehicle fleet.

1.6.1 Alternative Fuel Vehicles

The National Energy Policy Act sets forth requirements for states and federal fleets to increase the number of alternative fuel vehicles (AFV) operating in metropolitan areas of 250,000 residents or more. Under this regulation federal fleets of 20 or more vehicles must increase their acquisition of AFV to 25 percent by 1996 and 75 percent

by 1999. State fleets with 50 or more vehicles, must increase acquisition of AFV to 10 percent by 1996 and 75 percent by 2000. No final quota has been set forth municipalities, but many have already initiate the conversion to AFV (7:72).

The alternative fuels considered include ethanol, methanol, compress natural gas, propane, liquefied natural gas, liquefied petroleum gas and electric power. All the alternatives are being experimented with every day through the country. In can be safely said that none would probably satisfy the need for every single operation, however, there combined negative impact on the environment is anticipated to be considerably less than the currently used petroleum based products.

One of the preferred alternatives in fleet operations is compressed natural gas. It is available throughout the United States, is clean-burning and relatively non-combustible. It also requires minimal processing to convert to fuel, and compressed natural gas fueled vehicles make less noise than their diesel counterparts. A drawback of compressed natural gas is that the vehicle's fuel tank requires considerably more space than a regular gasoline or diesel tank for the same approximate mileage output. However, most of the other alternative have considerably more significant drawbacks. For example, methanol is toxic, corrosive and its emissions produce a cancer causing agent known as formaldehyde. Another example is ethanol, it is expensive and energy-intensive to produce.

Finally, converting to an alternative fuel fleet is not inexpensive. The biggest obstacle is the lack of infrastructure to support the conversion. The low volume of technology has driven the cost up. Yet, it is the manager responsibility to continue forward with the change since it is the change in itself what will increase technology

and drive the cost down. Moreover, the benefits to the environment and human health far outweigh the implementation drawbacks

1.7 Information Management Systems

Information is critical to the function of management. It has value, as it could permit, alter, enable, or empower action, assisting managers in achieving higher levels of effectiveness and efficiency. An information management system can be defined as a set of people, data and procedures working together for the purpose of providing timely and effective information to support decision making.

To understand information management, it is important to know the basic difference between data and information, and between data processing and information management. Figure 1 illustrates the relationship between data, information and knowledge.

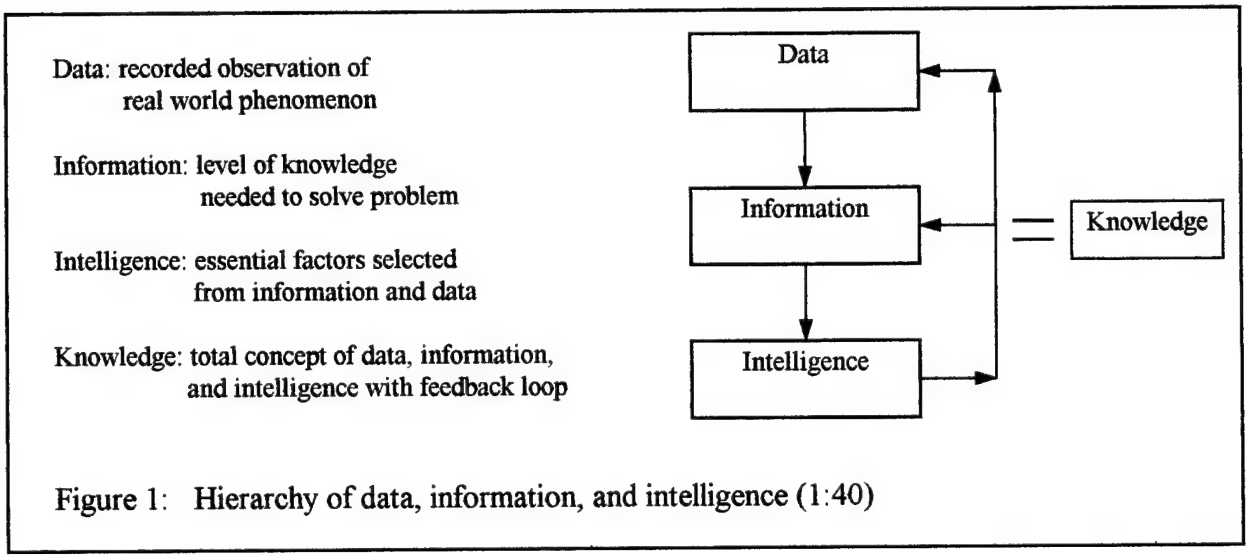


Figure 1: Hierarchy of data, information, and intelligence (1:40)

Data are pieces of facts independent in nature and unlimited in number. Information is the result of arranging this data into meaningful knowledge. For instance, a vehicle record is composed of various pieces of data, by processing various of these records we can convert this data into a cost relationship such as cost per mile per unit of time. Data Processing is the operation through which facts and figures are collected, assigned meaning, communicated to others, and/or retained for later use. It involve one of these activities: recording, classifying, sorting, calculating, summarizing, comparing, communication, storing and retrieving. In the fleet maintenance arena the data would be coming from shop records, repair orders, work orders, mechanic's reports, operator's reports, fuel tickets and blue books analysis among other sources. The management information system takes the data processing output and combines it with other external information to provide the manager a wider and better base for decision making.

Developing an effective information management system may take a lot of manpower and resources to design and implement. Chapter Four discusses proper selection and implementation of a management information system. Nevertheless, there are three basic questions that a manager should always ask during the planning stage:

- How should the information systems activities be organized?
- Who should get what information, when, at what cost, and to what extent? And,
- How capable are the current information systems, and how easily could they be updated to satisfy the changing information needs?

CHAPTER TWO

FLEET MANAGEMENT FUNCTIONS

2.1 Equipment Ownership

Fleet managers have several options when it comes to equipment ownership. Managers can own, rent or lease the fleet equipment or use a combination depending on the controlling factors. Some agencies allow the use of employee-owned vehicles for official businesses; however, this is not a common practice in the public works business. Among the controlling factors considered are the type of operation supported, investment capital available, size of fleet, maintenance equipment and facilities available, and operational cost factors.

2.1.1 Owned Equipment

Owning the equipment places the most burden on the fleet managers out of all the alternatives, because he or she are now responsible for maintaining and servicing the equipment as well as having to provide all the administrative support required to perform these tasks. When the organization is considering the outright purchase of equipment the following factors should be weighed:

- The extent and duration of warranty,
- The dealer reputation, and parts inventory,
- The owner's ability to handle the maintenance and repairs in addition to the possibility of having to stock sufficient parts to further reduce downtime, and,
- The financial capital available to support the purchase and associated costs (8:33).

After considering these factors the next step is to begin with the procurement process. The vehicle procurement process will have a direct impact on the efficiency of the fleet management operation. It is the critical step in getting the right vehicles or mix of vehicles for the job at hand within the available budget. The process can be summarized in the following steps (9:40):

- Determining the need. The person responsible for the vehicle purchasing should review the request with the users and other divisions in the organization that will be involved in the purchase. The objective is to gain an agreement on the basic requirements to avoid a costly conflict later.
- Developing the specifications. Important to develop a complete and accurate specification describing the true requirements as detail as possible.
- Testing the specifications. The objective of this step is to ensure that the specifications are practical, permit competition and will result in bids within a reasonable price range for the type of equipment to be purchased. Equipment data from various manufacturers should be reviewed and vendors should be invited to make a presentation to provide a forum for the staff to ask questions and fix in their minds the available equipment options.
- Developing the purchasing agreement. It is as important to develop well rounded purchase agreement as it is to develop sound technical specifications. The objective is to minimize the risk on the buyer. The following items should be covered: vendor experience; design principle and workmanship to control quality of the final product; regulations and standards to assure compliance with local, state and federal regulations; a user list to check prior performance; parts

availability and response time to establish a set service time; specifying a local dealer to enhance the service response by providing close support to the operation; requirement for technical documentation such as equipment operation and maintenance manuals; and training by contractor for operators and mechanics.

- Developing the mailing list. In the case of sophisticated equipment it is particularly important to provide a comprehensive list of vendors to be solicited for bids. The objective is to maximize the participation of qualified bidder.
- Analyzing the bid and making the award. Conduct a thorough review of all the bid documents for compliance. It is recommended that the bids be tabulated to facilitate comparison, and made available to the user for discussion and resolution of conflicts.
- Monitoring production and inspecting upon delivery. The purpose of the monitoring is twofold: to give the mechanics a "from-the-ground-up" look at the vehicle; and to demonstrate the buyer's concern for manufacturing quality. The monitoring visit should be scheduled at natural points in the assembly process, such as when the prototype is finished, and when testing is conducted. Finally, conduct a post-delivery/pre-acceptance inspection for any latent or en-route discrepancies.

As for the bidding process, many municipalities have experienced problems with the low-bid process and have turned to life cycle costing. (9:40). The advantage of life cycle costing is that it considers long-term after-purchase factors including operating and repair costs, life expectancy and the disposal value of the equipment. However, it usefulness is limited to heavy duty equipment such as bulldozers and graders, because

of the predictable nature of their utilization. Smaller vehicle such as sedans and pick-up trucks do not lend themselves for this type of purchase because the uncertainty in operation places an unacceptable risk on vendors. Nevertheless, life cycle costing should be used when considering acquisition of heavy equipment because it is an efficient way to control cost.

Typically, the life cycle costing process would begins with the bid price of the equipment, then adds a guaranteed maintenance cost over an agreed-upon service life, and finally subtracts a guaranteed buy-back or trade-in figure. The winner, when using the life-cycle cost procedures, would be selected based on the lowest cost per hour of operation.

Another option being used by fleet managers is the open-end order. It is used whenever the organization is buying the same type vehicle for several years. This option saves the administrative cost of re-bidding the contract as well as achieves fleet standardization, avoids problems with operator's and mechanic's training, and reduces the volume of parts that must be stocked.

Ownership requires the highest capital investment. Although it gives the manager the greatest flexibility, it places a considerable financial burden on the organization. Small municipalities or departments with limited capital should consider rental or lease of equipment.

2.1.2 Rented or Leased Equipment

Renting equipment reduces the workload on management because it minimizes the concern with administrative headaches such as licensing, accident reports, warranty

claims, fuel storage, disposal of tires, used oil, and/or hazardous waste. It also minimizes the impact of vehicle breakdown on the agency's operation because the renter must provide operational equipment at all times. Equipment rental should be considered in the following situations:

- To take care of peak seasonal work loads, such as street repairs or snow removal.
- To supply special equipment that they find not economical to own and maintain.
- Whenever undertaking of special projects with in-house forces. And,
- In cases of emergency or breakdown of owned equipment.

Leasing equipment is another alternative available to fleet managers. Leasing can lower maintenance costs and does not require the full capital outlay that purchasing does. According to the Department of Fleet Management, Knoxville, Tennessee, leasing may be a feasible alternative of equipment replacement if any of the following conditions are typical of the operation (10:A-6):

- Capital funds for equipment replacement have low priority and funding is unpredictable from year to year.
- The tendency is to retain equipment beyond its useful life.
- Equipment acquired is suitable for leasing or lease purchase. And,
- There is an inability to recover fair market value of surplus equipment because of legal restriction or local market conditions.

Leasing is offered under a variety of names, but they are a combination of three basic lease types: open-end lease, closed-end lease, and lease purchase. The preferred

option being the closed-end leased. The basic differences between open and closed end leasing lies on the residual risk factor. In the open-end lease the lessee, in this case the public works department, is responsible for recovering the residual value at lease-end. The main advantage of open-end-leasing is that it typically offers lower monthly payments than a closed-end-lease.

In the closed-end lease the lessee negotiates a fix rate for a set period of time under a predetermined operational schedule that regulates mileage and maintenance for the leased equipment. Failure to meet these negotiated terms results in penalties. The total lease costs are fixed up front, with the lessor assuming all risk for the recovery of the residual value at lease end. Equipment suitable for closed-end-leasing includes vehicles with good resale value such as sedans, pick-up trucks, stake trucks and medium-duty dump trucks. From the perspective of the equipment manager, the normally fixed cost of depreciation is converted to a controlled operating expenses. Another advantages of closed-end-leasing are that it facilitates scheduling of vehicle replacement, and foster good fleet management practices because of the need to control wear and tear, and mileage.

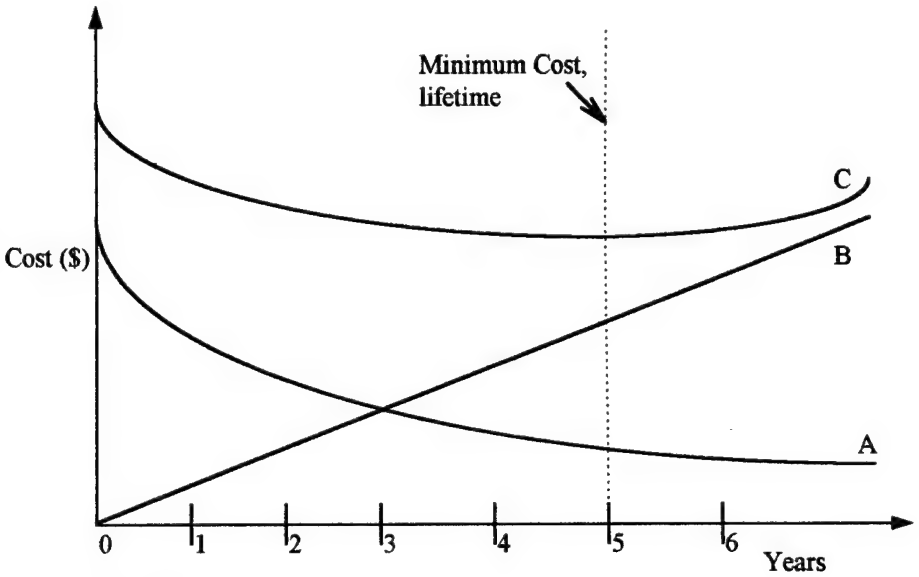
2.1.3 Equipment Replacement

Every piece of equipment in the public works fleet has to be replaced at some point in time. There may be as many approaches to determining the optimum time for replacement as there are fleet managers. This section presents three approaches

commonly used by managers to determine the optimum vehicle replacement time. These are the average annual cost analysis, the nomogram, and the point system.

2.1.3.1 The Annual Cost Analysis

It could be said that a piece of equipment has three lives. The service life or amount of time the vehicle is capable of operating and rendering service. The technological life or relative productivity decline of the unit when compared with newer models on the markets. And, the economic life which relates to the total stream of costs associated with the unit through time. The economic life has the more significant impact on the both capital and operating budgets (1:192). Figure 2 illustrates the relationship between these three lives or costs.



A-Decline in resale value
B-Operating and maintenance costs
C-Average of annual costs to date

Figure 2: Relations of resale, operating and maintenance, and average annual costs for motor vehicles (1:193).

In the early years, the ownership costs are dominated by the declining resale value or depreciation of the vehicle. In the later years the decline in resale value slows, whereas operating and maintenance costs continue to rise. In this example, a minimum average annual cost is reached after about five years, followed by a steady increase. It is important to recognize that the economically optimum replacement point is reached when the average period costs are at a minimum, not when the total period costs are at a minimum. This is known as the average or mean annual cost analysis.

2.1.3.2 The Nomogram Approach

Another approach is the use of a nomogram. A nomogram is a graphical representation of a complicated algebraic equation. The information depicted in the nomogram would include capital cost of the present equipment, total maintenance cost to date, the age of the unit, the maximum cost of the projected repairs for the next year, and the capital cost of a replacement unit. The projected cost of repairs for the coming year will determine whether replacement is necessary. Figure 3 presents an example of a typical nomogram for vehicle replacement. In this particular case the equipment in question should be replaced when the it maintenance cost for the projected year exceeds $3,300.00.

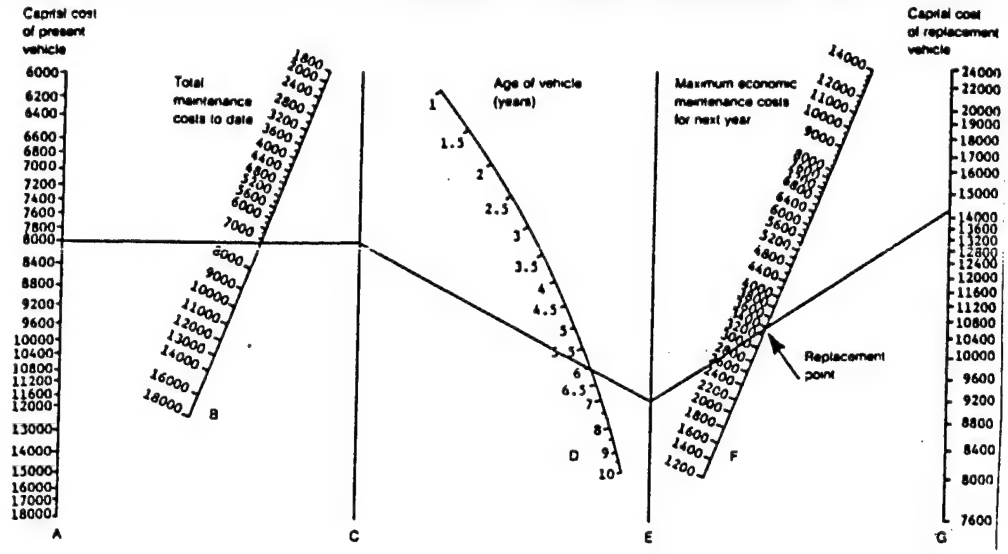


Figure 3: Nomogram for vehicle replacement (1:194)

Initial cost: $8,000.
Total cost to date: $14,000.
Replace the vehicle when the maintenance cost for the next year is projected at $3,300 or more.

2.1.3.3 The Point Rating System

The final approach presented is the point system (10:A-6). It is simply a scoring or rating system based on a predetermined evaluative criteria. All vehicle scoring higher than the allowable limit are scheduled for replacement. As an example, the Department of Forestry of the State of Oregon evaluates their vehicles based on four criteria: operating cost per mile, age, mileage, and condition of the vehicle's body and mechanical components. The department then compares these findings to its own standards for how a similar vehicle should be performing and assigns a rating to each vehicle criterion based on how it compares to these standards. The ratings are low, standard, high and extreme. Points are assessed according to the ratings with the most points going to extreme in a scale from one to four. Any vehicle with a score higher than eight is considered for replacement.

In summary, the replacement process can be as complicated or as simple as the situation warrants. It is up to the equipment manager to select the process that will provide the greatest return on the replacement dollar. Nevertheless, the manager must have a process in place, arbitrary replacement based on age and mileage simply do not hold up in the face of tight budgets. Appendix A has a recommended policy guide for major equipment purchase and replacement (11:65).

2.2 Equipment Utilization

The misuse and mishandling of equipment can waste the public funds just as surely as the misuse of materials and supplies or mishandling of personnel. Care in utilizing equipment requires attention to the assignment of equipment, utilization balancing, operator's training, and the control and analysis of operations through an information management system. Sections 2.2.1, 2.2.2 and 2.2.3 discuss the assignment of equipment, utilization balancing, and operator's training and responsibility issues. Management information system are discussed later in Chapter Three.

2.2.1 Assignment of Equipment

Assignment of equipment to operators must be made carefully and reviewed regularly in order to have effective use of each item. It is important to select the right people and assign them to the right equipment. Operators should be tested for their knowledge and capabilities in relation to intended assignments. They should undergo a thorough physical examination and vision tests. A classification system should be used to find the optimum assignment of operator and equipment. Besides,

classification facilitates handling promotions, equity in pay, budget preparation and training requirements.

2.2.2 Utilization Balancing

The typical motor vehicle fleet for a city or county public works is quite diverse, and even with similar equipment, the kind and intensity of use will vary widely. Utilization balancing is a management tool used to reduce fleet costs by balancing usage of all units with a specific class or type and within a specific year. The goal is to exchange like units having dissimilar utilization at various points in time to achieve a balanced utilization at the completion of the unit's economic life. Utilization balancing allows the manager to better plan and budget equipment replacement (1:195).

2.2.3. Operator's Training and Responsibility

Safe and efficient operation of the public works equipment is necessary for the organization to be cost efficient. The service life is a function of the operator's skills and understanding of his or her responsibilities as much as it is a function of the maintenance program.

Training of equipment operators and mechanics is extremely important because it results in increased safety and efficiency, and consequent savings in time and money. A trained operator can do more work, will need less supervision, will have fewer accidents and will cause less damage to the equipment; thereby, prolonging its service life and reducing its maintenance costs. A good training program should include the following: safe and efficient operation of the equipment, field servicing, methods of

operating special equipment, spotting symptoms of defects, maintaining daily reports, and procedures to follow in reporting defects and accidents.

The responsibilities of the operator will vary depending on the equipment, location and type of operation, but as a rule of thump, the operators should be responsible for performing the pre-start check when taking the unit out for the first time, be in the look out for abnormal operation and be capable of reporting defects.

Equipment operators have the foremost responsibility for keeping a vehicle in proper operating condition, and it is the responsibility of the fleet manager to communicate this point to the operators, so they recognize the importance of their duties, and their impact on the operation should they failed to perform it. The manager must continuously upgrade the operation through a comprehensive training program.

2.3 Maintenance of Equipment

The maintenance of equipment involves many factors such as the organization to accomplish the work, equipment servicing, preventive maintenance and replacement policy. Section 2.3.1 and 2.3.2 discuss these factors and real life examples of successful management.

2.3.1 Equipment Servicing

Efficient equipment servicing requires adequate facilities, proper equipment, effective scheduling, and trained personnel. Developing a new service center facility at an affordable cost often presents a problem for municipalities or governmental

agencies which are faced with conflicting demands for more visible and higher priority public improvement projects. Is here where the creativity and resourcefulness of the manager make the difference. In Kansas City, Missouri, the city overcame this problem by acquiring an existing facility and adapting it to meet its needs. From the original concept of a 150,000 square foot facility, they acquired over 500,000 square foot from an old truck manufacturing company for approximately $35 per square foot versus the estimated $60 per square foot of a new facility (12:50).

Planning for a new equipment service facility requires a detailed analysis of the public works functions, equipment requirements, locations, construction factors, and space requirements (12:50). Next is a list of some of the issues to be considered in the analysis (13:74):

- The fleet size and composition to be served by the facility.
- The frequency of maintenance and the amount of preventive maintenance versus breakdown maintenance.
- Whether maintenance and fueling are centralized or decentralized.
- Site location: accessibility, land use, terrain, land cost, utilities, expansion needs and possibilities, storage, traffic control, and easements.
- An outline of the building showing walls, floor, foundation and structure.
- An outline of the space requirement for equipment, material storage and office spaces. And,
- How much maintenance is contracted out to private vehicle maintenance facilities.

The amount and nature of the garage facilities and shop equipment depends on the volume of activity and policy on the use of outside garages and shops. The facilities should be adequate for the jobs they are expected to do, but not over-equipped. Specialized equipment rarely used should not be purchased and contracting-out should be considered for this service.

Scheduled maintenance is another important factor . A scheduled maintenance program should be developed for satisfactory servicing of the equipment. It will vary depending on the size and type of the equipment, and the operation. It is usually based on one of the following factors: mileage, time, fuel consumption, calendar period, engine-hour or engine-time (1:198). Scheduled maintenance can be defined as the inspection and servicing of motor vehicles at intervals compatible with the manufacturers' recommendations for lubrication and mechanical services and it is an essential part of preventive maintenance.

2.3.2 Preventive Maintenance

Preventive maintenance requires the systematic inspection of the equipment and the correction of detected defects to prevent failure. Such maintenance calls for constant vigilance on the part of the operators, servicemen, and maintenance mechanics following prescribed procedures for periodic inspections, minor maintenance and major overhauls. This phase of equipment management is most important because too much as well as too little preventive work can result in excessive operational cost. Typically, preventive maintenance inspections are divided into three classes. These are (1:198):

- Class A. An inspection of all lubrication and mechanical services as recommended by the manufacturer plus an inspection of all parts and component related to the safe operation of the equipment.
- Class B. Same as Class A plus an inspection of components having a high rate of wear or deterioration or in need of frequent adjustment.
- Class C. Includes all elements of a Class A and B plus a complete check of all remaining components and assemblies of the unit.
- The usual pattern of inspection is A, B, A, B, A, C, cycling every one to two years.

Regardless of the effectiveness of the preventive maintenance program the manager should plan on having unscheduled maintenance to some degree. Unscheduled or corrective maintenance usually arises from either an operator's report or an emergency road call. It is defined as the correction of deficiencies that occurs between scheduled inspections, such as safety inspections, and the scheduled preventive maintenance servicing. The manager should recognize this blend of preventive and corrective maintenance, and determine the optimum ratio based on cost and operational requirements.

An effective preventive maintenance program will result in reduced capital investment costs, prolonged service life, reduced part inventory, and increased productivity.

2.4 Financing Equipment Services and Cost Control

The most common ways of financing an equipment servicing operation are through a working capital or revolving funds, and the rental system. A working capital fund is used to set aside sufficient money in separate funds to finance the service operations until money for services rendered can be returned to the fund through reimbursement from the departments and agencies that received the services (12:91).

A more effective method of financing the cost of equipment services is the use of a rental system. Agencies utilizing the centralized equipment management approach have found that the rental system did simplify procedures and provided improved cost control. The public works organization assumes "ownership" of the equipment and rents the units to the using departments on a cost per mile, cost per hour or a flat monthly charge. The rental rates include all costs assigned to the fleet, and thus the equipment management organization's budget is totally recovered from the rental rate structure.

In addition, the rental system give both the using agency and the fleet management organization improved cost control. It provides an operating cost based on vehicle performance, enabling the using agency to evaluate its vehicle efficiency, and an accurate projection of the upcoming year's budget for the fleet management organization. For example, a typical budgeting process would begin with the issuance of equipment rental rates and a request to the customers to estimate their equipment requirements for the upcoming year. Once this information is available the rental rates are multiplied by the projected customer utilization, resulting in an accurate projection of the next year's budget.

Normally, the equipment rental rates are based on the estimated expenses of operating and maintaining each piece of equipment through out its anticipated service life. However, many agencies have included the replacement cost in addition to the operating and maintenance costs. The North Carolina Department of Transportation explained that although it resulted in a slight increase in the annual overall rental cost, the benefits far outweighed the increase. Benefits included an increase in productivity, greater equipment availability, on time replacement of obsolete equipment, less downtime, and the capability to purchase better quality and improved designed equipment, resulting in a significant improvement of customer services (14:56).

CHAPTER THREE

FLEET MANANGEMENT INFORMATION SYSTEMS

3.1 Fleet Management Information Systems

In the 1990s and beyond, the fleet managers must be supported by a sound management information system to manage the ever increasing quantities of data and be able to synthesize the information into knowledge to make effective decisions and formulate practical operating strategies. Fleet management information systems were designed with these major objectives in mind: reducing inventory by keeping fewer spare units, lowering ownership costs, decreasing downtime and in-service break-down, and forcing managers and others involved to be aware of the need to reduce costs and avoid wastes (15:64).

The data collection should be a byproduct of the daily operations. It is collected, collated, manipulated, and summarized for reporting information to appropriate higher levels in the organizational structure. The information flow in a modern fleet management/maintenance information system should be like this (16:A-41):

A. When the equipment is purchased its serial number and number of the major components are entered into the system.

B. When work is to be done on the equipment, the job is started by a work initiator as follows:

   1) Preventive maintenance is triggered by a computer generated report based on time, mileage or any of the other factors listed in section 2.3.2.

2) Response to breakdown is triggered by a telephone call or printed message from the operator or dispatcher.

3) Operator defect reporting is accomplished by using a computerized optical scanner triggered by the operator's time card.

4) Adverse information from a fluids management system is fed from a remote "electronic clipboard" at the pump station.

5) Corrective work uncovered by preventive maintenance is triggered from a terminal in the garage.

C. The above information is stored and sorted as desired for reporting, and available to the shop foreman for an up-to-date list of all work pending. In addition, the foreman or the designated person is able to electronically assign work or defer it based on:

1) Vehicle number

2) Component type

3) Estimated time of repair

D. When the work begins, the worker clock by scanning his bar-coded identification number and the computer automatically assigns a job number.

E. Parts and tools are pre-positioned by the computer as function of the type of work. The system should also alert the parts division and initiate ordering if the part is not available in the inventory. Also, it should alert management if the part to be repaired or replaced is still under warranty.

F. Upon completion of the work the mechanic clocks off and prepares for the next assignment, the foreman's queue is automatically adjusted, and all pertinent information is stored in the computer.

A modern fleet management information system should be capable of producing the following reports:

- Most likely cost of defect,
- Most common defects,
- Which vehicles require the most repairs,
- Evaluation of mechanic's performance,
- Which vehicle operators have the most breakdowns,
- Whether maintenance performance trends are positive or negative,
- Which components have the least life cycle cost, and,
- Whether it is cheaper to contract out or use in-house forces.

The information has always been available. All of these reports and analyses have always being doable, however, the manpower and resources necessary represented, in many occasions, an unacceptable costs to the agencies. Computerized fleet management information system provides a cost efficient procedure to access and manipulate this information.

A fleet management information system is a necessity in today's equipment management. It is the tool that brings all the different aspects of equipment management together, providing quality manpower assessments, root-cause analysis, looking for repetitive repairs per vehicle and/or type of vehicles, automating shop operations, providing real time information output, and increasing responsibility and

the sense of ownership for the equipment by making the mechanics responsible for setting up maintenance schedule, ordering parts and everything needed to keep a vehicle on the road. Appendix B provides a summary of the information management requirements for a typical equipment management system.

3.2 Implementing a Fleet Management Information System

Successfully achieving the benefits of implementing a fleet management information system requires a careful selection of the right software program, evaluating hardware needs, planning the network design, training, and reengineering the way maintenance is accomplished. Purchasing a complex software program, but continuing to conduct business as usual will not reduce inventories, downtime or increase productivity. It requires change, and the manager must understand that bringing change into an organization takes great determination and is generally met with strong resistance. In fact, studies have shown that management itself is many times the greatest obstacle in the implementation of a new management information system (17:70).

The process of implementation can be separated in two stages: analysis of current operation; and, implementation. The following rules should be followed during the analysis stage (18:36):

- Management must be committed to meaningful involvement. Strive hard to get everyone affected by the change involved in the process.
- Document how maintenance is currently done.

- Set clear goals and objectives. Create a vision of how a computerized management system could be used to make the job of administering the fleet operations easier. Define successful implementation. Set measurable objectives.
- Diagnose the problem before prescribing a solution. Avoid the "quick fix" approach. Establish a collective agreement on the real issues affecting maintenance and prescribe common practices and procedures as solutions. An organization moving in a common direction is nearly unstoppable.

Once the problem has been defined and the objective set, the organization is ready for implementation. The following steps should be followed to ensure an efficient transition and high acceptance:

- Get outside help. Whenever possible use a third party to serve as a neutral facilitator. This person should be experience in the field. His or her job is to oversee the implementation, take care of the problems and facilitate the information flow.
- Begin and end with a maintenance audit. The organization must be able to measure performance at both the beginning and end of the process to determine the degree of success. Areas that to be considered for auditing are: equipment records; repair orders backlog; number of items and value of part inventory; ratio between preventive versus corrective maintenance; man-hours expended in non-productive tasking; and, number of emergency call outs.

- Define compelling reasons to change the way maintenance is accomplished. This will help maintain the momentum and willingness to change. The organization must understand and accept the compelling reasons for change.
- Establish roles and involvement throughout the organization. This will allow the personnel to identify with the change and give them a sense of belonging.
- Define the mission of maintenance services. Collectively agree on new maintenance philosophy, practices and procedures The objective of this step is to breakaway from the reactive mentality, and move on to a proactive mentality.
- Establish maintenance service agreements defining what are acceptable levels of service. For example, what is the acceptable ratio between preventive and corrective type maintenance.
- Establish maintenance goal indicators and continuously measure and monitor their success. These measurements should not be used to evaluate individual performance, only organizational performance. When data are used to track individual performance, fear is manifested in the organization, as a result, inaccurate information is reported.

In summary, implementing an information management system involves organizational change. It requires establishing clear and meaningful purpose, and a vision of how it will improve the operation, resulting in commitment and involvement in the process. Developing a collective agreement on the new procedures accelerates implementation. Evaluating maintenance indicator keeps the organization on course and improves maintenance productivity by focusing on the system, not the individuals.

CHAPTER FOUR

A CURSORY REVIEW OF THE ALACHUA COUNTY AND THE UNVIVERSITY OF FLORIDA MOTOR VEHICLE FLEET MANAGEMENT

The author conducted a cursory review of the motor vehicle fleet management operations of the Alachua County's Public Works Department and the Physical Plant Division at the University of Florida with the purpose of comparing the principles, trends and techniques discussed in this report with actual operations. The following individuals were interviewed:

- In Alachua County, Mr. Wendell Chastain, Fleet Management Superintendent, Public Works Department.
- In the University of Florida, the auto and equipment maintenance superintendent for the Physical Plant Division Motor Pool, Mr. Harrell B. McCrory Jr. and the his lead technician, Mr. Derrick Williams. And,
- In the University of Florida, Physical Plant Division, Work Management Center Engineer, Mr. Gordon P. Frederick.

Sections 5.1and 5.2 summarize the interviews.

4.1 The Alachua County Office of Fleet Management

The Office of Fleet Management is under the county's public works department organization. It is located in state road 441, northwest of the City of Gainesville, Florida. Figures 3 shows its organizational structure. The office is responsible for maintaining, replacing, procuring, and managing about 550 pieces of equipment belonging to several county offices and departments. The type of vehicle serviced

varies, from the relatively easy to maintain sedan or pickup truck to a labor intensive fire rescue vehicle.

The office operates under an internal service fund. They have to generate their own revenues to pay for the cost of doing business. They use a fully burdened repair rate that covers all costs except fuel, which is charged separately. It is very similar to competitive budgeting.

Currently, they are in the process of implementing a new management information system. The goal is to reduce the overhead cost per unit. The county agencies do not have to use their services, they may go to the private sector. Therefore, they must remain competitive. The new system will allow them to handle the increased workload with the same size administrative staff. The cost of the new management information system software was $18,000. Implementation began on April 1996 and is expected to be completed by October 1, 1996. The system will significantly reduce the paperwork and duplication of work. It will link all the offices within the fleet management department via a computer network that provides the user with real time outputs and allow lower echelon personnel to enter data into the equipment record directly from their work stations. The program is an off-the-shelve product. The developer provides the training and assistance during the installation as well as consultation and support services throughout its service life. Everyone in the organization was given the opportunity to provide input during the selection process. The information flow and analysis capability of the system are very similar to those described in section 3.1.

The office considers vehicles for replacement once they go pass the five year mark or over a 100,000 miles. The manager explained that they must be flexible and considered each vehicle individually once the above criteria is met. He pointed out that usage, marketability, and technology must be evaluated, as well. They use a total cost equipment purchasing procedure to facilitate the equipment replacement. This process is similar to the life-cycle costing process discussed in section 2.1.1. The vendors guarantee that they will buy back the equipment upon reaching a predetermined time or mileage as well as the cost of maintaining the particular piece of equipment. Additional maintenance costs are paid for by the vendors. Also, this procedure assists the manager in establishing a more reliable budget for a predetermined period of time.

Environmental regulations have had some impact on the operation, mainly the infrastructure. They installed a $30,000 freon reclamation system and a $50,000 storm water run-off collection system with zero discharge, reusing 100 percent of the water collected from degreasing and vehicle washing. Although federal regulations do not require the county to begin conversion of its fleet to alternative fuel vehicles, they have initiated replacement on a trial basis. The preferred alternative has been compressed natural gas. Compressed natural gas cost them about 40 to 60 percent less per equivalent gallon of diesel. However, the lack of infrastructure raised the conversion cost to levels that the county was not able to fully support. The estimated conversion cost per vehicle was $4,000. The program is currently on hold.

Finally, Mr. Chastain explained that an effective the manager must have a sound understanding of these five basic aspects of the organization: parts, tools, training,

facilities and the technical know-how. Always keeping in mind that their main goal is to satisfy the customer's needs.

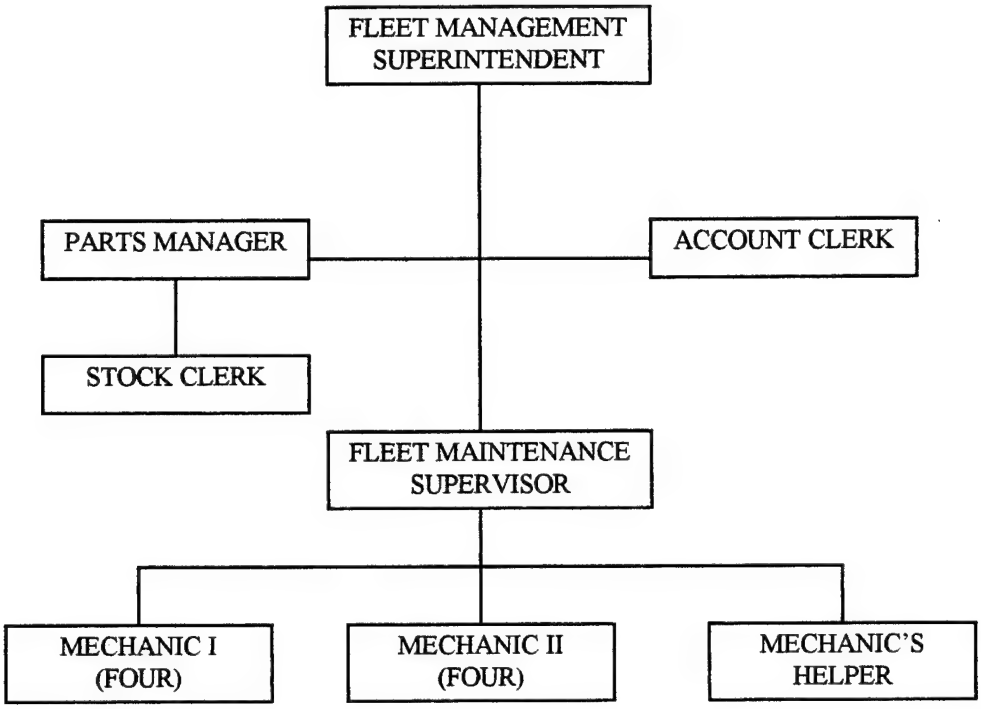


Figure 4: Alachua County, Office of Fleet Management Organizational Chart.

4.2 Public Works Equipment Management at the University of Florida

The fleet management responsibilities in the University of Florida were separated among the physical plant division and the individual departments in the early 1990s. For approximately nine years, the university had an appointed fleet manager, but in 1990, after relative modernization of the fleet and internal reorganization, the position was eliminated and the individual department assumed some of the fleet management tasking.

The motor pool became part of the Physical Plant Division (PPD) on July 1, 1994. Prior, it was under the control of the Department of Management Services for the State of Florida. The management responsibility was turned over to the University of Florida in an effort to centralized equipment management. Although the facility's major user is the University of Florida, a diverse group of other State agencies are also served. Currently, the Physical Plant Division Motor Pool is responsible for providing fuel and repair facilities for all State of Florida owned vehicles. Figure 4 shows the motor pool organizational structure.

The motor pool performs the most common vehicle repairs, serving a fleet of approximately 1,100 vehicles. They utilize a combination of in-house and local vendors. Specialized services such as windshield replacement, upholstery, alignment, glass work and welding are contracted out. Equipment procurement, replacement, and preventive maintenance are coordinated with the departments through the Work Management Center, a separate office within the PPD.

The motor pool division is currently implementing a new fleet management system developed by university personnel. The motor pool superintendent prefers the in-house product to an off-the-shelve software package because it is tailored made to fit the operation. The program developer is responsible for providing the training and consultation services. The initial workload required to bring the system data banks to acceptable levels forced them to hire an additional typist clerk. However, this is temporary position, anticipated to disappear once the implementation is completed by the end of 1996. The implementation has been slow and it is about six months behind schedule. They are still using much of the paperwork that will eventually be

eliminated. The superintendent explained that the new system allows them to correlate enormous amount of information to vehicles and personnel for the purpose of evaluating performance and determining problem areas. He explained that the information has always being available, however, in too many instances, the manpower efforts required to collate it was not a justifiable expense because of budget limitations. Appendix C illustrates some of the analysis that they are capable of generating with the new management information system.

Compliance with environmental regulation has not have a significant impact on the motor pool operation. The university tried out an electric vehicle as an alternative to gasoline, however the electric vehicle cost them 2 ½ times more to acquire and nearly 3 ½ times more to maintain than a gasoline vehicle in equivalent service. The program was discontinued after a two year trial. Appendix D presents the vehicle description and characteristics. Appendix E is a summary of the study.

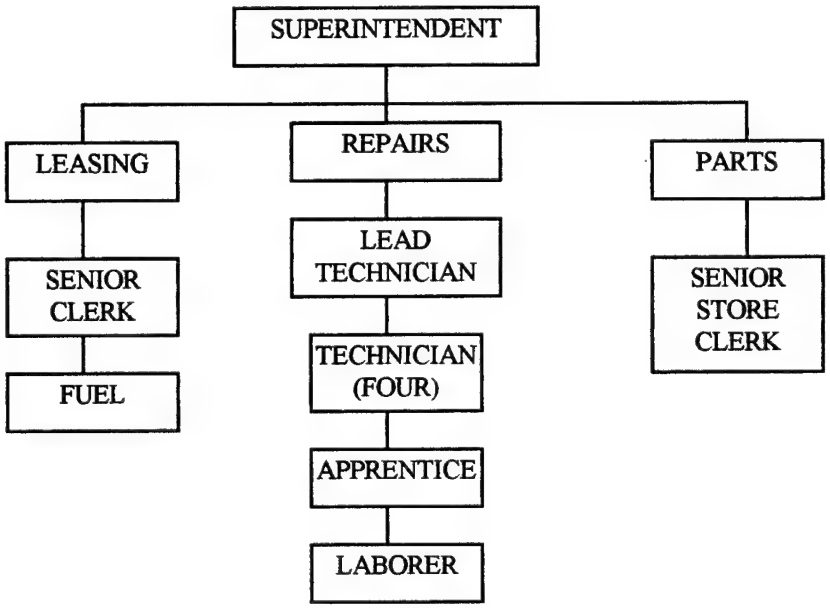


Figure 5: University of Florida, Motor Pool Organizational Chart.

4.3 Observations

The most significant observation of this study is that the University of Florida does not have a Fleet Manager or a consolidated fleet management program. The university does not have that one person who is responsible for the overall equipment management functions. Instead, some of the functions are distributed to departments that are managed by people that may not be technically trained or professionally experienced in this field. Since the management functions are dispersed, it is difficult to coordinate and delegate functional responsibilities as effectively as a single manager could.

On the other hand, Alachua County has encompassed the concepts of total equipment management. The office of fleet management, under the public works department, has assumed full responsibility for the maintenance and management of the county's motor vehicle fleet. This centralized approach allows the managing organization to set goals and objectives that will fit the entire spectrum of customers, and gives them the necessary flexibility to adjust to changes in priorities. They understand that effectively *managing* the fleet is the best way to provide the highest level of service for the lowest possible cost.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The objective of fleet management is to provide effective and dependable equipment that is properly designed to furnish the necessary service at the lowest possible cost. This report provides a concise guide from which to develop an effective fleet management program. The material here presented renders the following conclusion:

1. The fleet management organization will vary with location and type of operation as well as the financial and technological resources available. However, the equipment management principles are universal, and will fit any type or size operation.
2. Management of public works equipment has gone from a purely maintenance oriented approach to a managerial approach, brought about by an ever decreasing budget, increasing service requirements, new regulations, and a dynamic technology. This shift has created a very competitive operation. Today's public works equipment managers must be capable of planning, analyzing, measuring, evaluating and managing complex operations. The key word being *managing*.
3. An effective fleet management program will guide the organization through the process of determining the major objectives of the fleet operation, and defines

the strategies that will govern the acquisition and utilization of the resources to achieve these objectives.

4. Managing the public works equipment fleet should always be given priority within a public works organization. Equipment is to public works, what arms and legs are to humans, not much can be accomplished without their proper functioning. Effective fleet management is essential to the success of a public works organization.

5.2 Recommendations

1. Local and municipal public works departments must develop and implement a written policy or strategic management plan to provide for the effective management of the equipment fleet.
2. The organization must continuously upgrade the operation through training. Everyone involve should be encouraged and allowed participation. This foster a sense of belonging and commitment to the organization.
3. The fleet management program should allow for continuous evaluation to determine the needs, strategies, and procedures in the management of the equipment to guarantee the effectiveness of the process.
4. Privatizing should always be considered as a viable alternative to reduces cost and provide the necessary service.

APPENDIXES

APPENDIX A

POLICY GUIDE FOR MAJOR EQUIPMENT PURCHASE AND REPLACEMENT

Need for Equipment

New equipment is needed to replace units currently in use or for new procedures and projects. Before retiring existing equipment or buying new equipment, the following factors should be considered:

- What is the primary function of item to be replaced?
- Is the present equipment performing the tasks assigned to it economically and efficiently?
- Is the present equipment user friendly?
- Does the present equipment have a good maintenance record and is it easy to maintain?
- Is there new equipment available to perform assigned task more efficiently than the equipment to be replaced?
- Would proposed additional equipment be used for a temporary project or become part of the equipment fleet?
- If new equipment is to become part of the fleet, contractors using such equipment should be contacted and evaluations made of the equipment performing similar tasks.

Performance Evaluation

When evaluating the performance of existing equipment the following should occur:

- Seek present equipment operators' and foreman's views and opinions on current equipment.
- Seek vehicle maintenance division's views and opinions on current equipment regarding maintenance and maintainability.
- A proper evaluation of data received from these sources will indicate and highlight needs for changes or additions to current specifications for equipment to be replaced. This information can then be formulated into new specifications for said equipment.

Preparation of Specifications

- Continuously update current specifications to keep pace with state of the art for such units.
- Seek professional counseling for specifications for new and specialized equipment.
- Prepare clear, detailed, and concise specifications, leaving no room for misinterpretation or downgrading by prospective vendor.
- Before submitting specialized equipment for bidding, a prebid conference should be held with prospective vendors.

Evaluation

Before the decision is finalized for request to purchase the new equipment the following study should be performed:

- Evaluate how many days/weeks/months/years this item will be used.
- Evaluate ownership versus rental and lease.

APPENDIX B

SUMMARY OF INFORMATION MANAGEMENT REQUIREMENTS FOR AN EQUIPMENT MANAGEMENT SYSTEM

Equipment

- Detailed description of all vehicles and equipment.
- Equipment status and condition reports.
- Depreciation schedule.
- Equipment assignment (location/staff).
- Equipment specifications.

Maintenance

- Records of all repairs (preventive, maintenance, emergency, vendors, and warranty).
- 12-months history (on-line).
- Equipment life history (on tape).
- Billings of departments.
- Preventive maintenance scheduling.

Parts Inventory and Control

- Detailed parts inventory.
- Integration of equipment with purchasing system.
- Critical reorder parameters.
- Parts control (receipt, issuance, charges, transfer, return).
- Handling of both used and new parts.

Work Orders

- Labor and parts
- Updating of equipment, maintenance, parts and performance evaluation files.

Fuel Inventory and Control

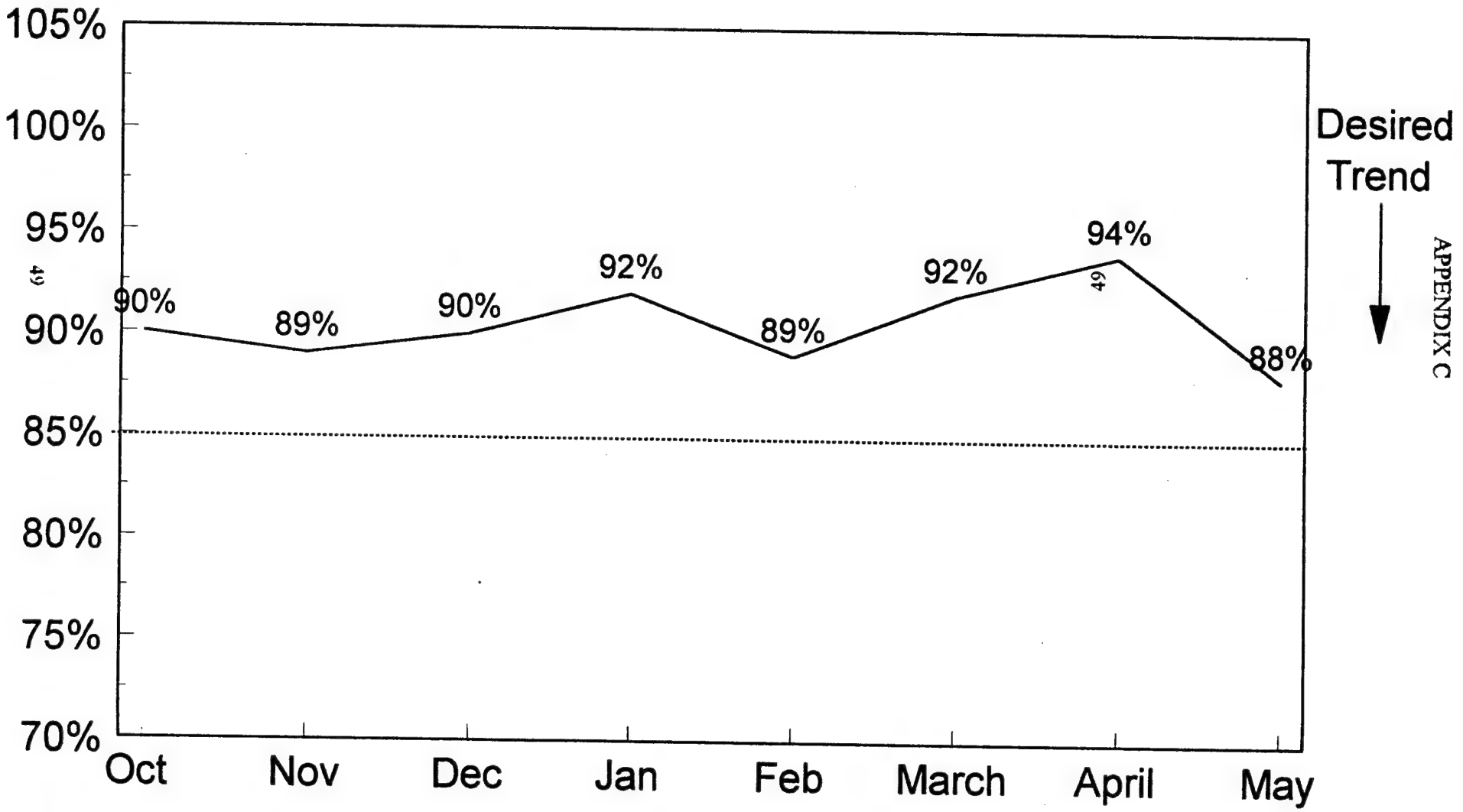
- Inventory status for all fuel dispensing stations.
- Fuel dispensing records.
- Fuel use by vehicle.
- Integration of fuel inventory with purchasing system.
- Critical reorder parameters.

Productivity and Performance Auditing

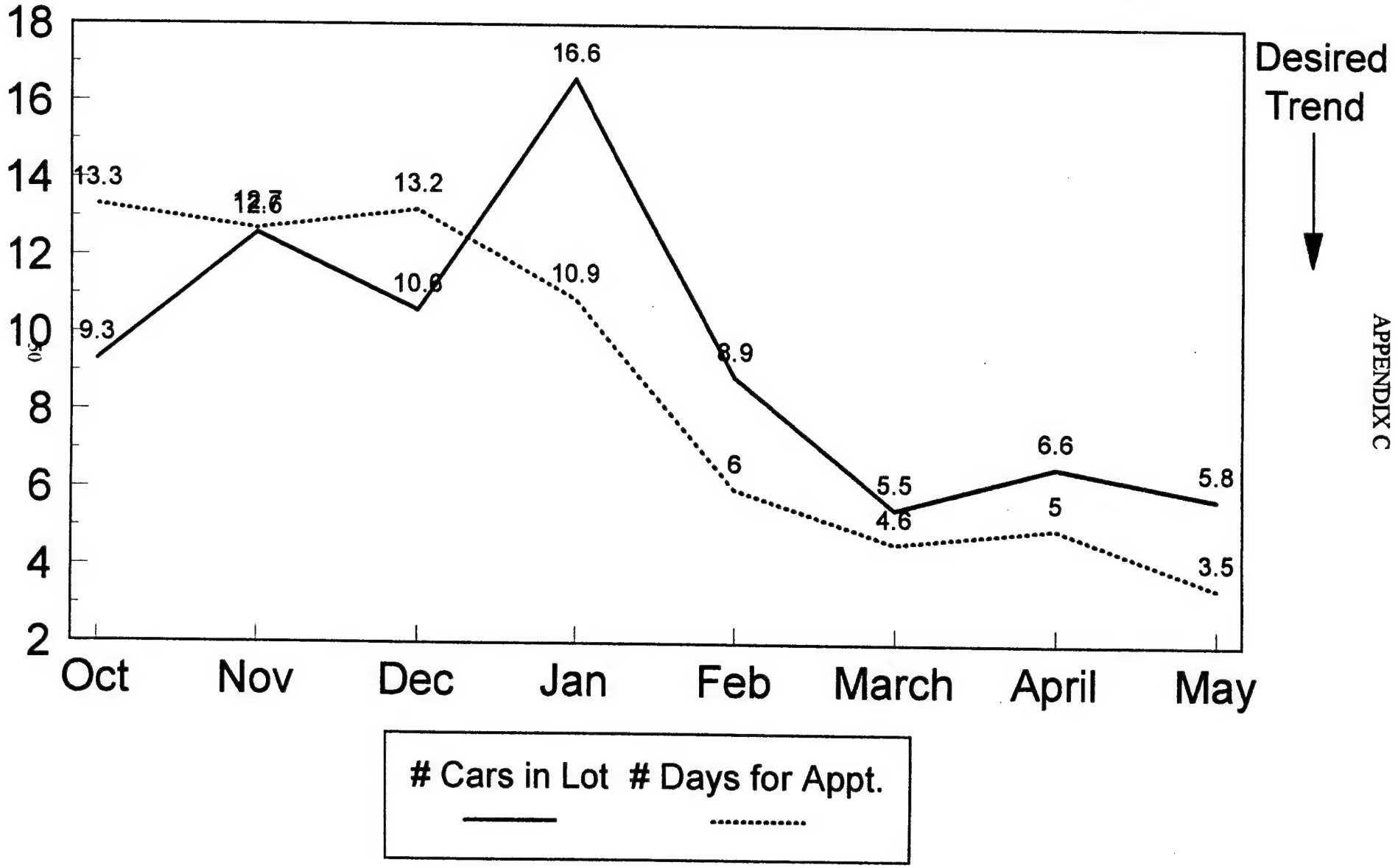
- Performance standards.
- Performance reports (actual versus performance standards, by type of activity, by repair, by employee)

Repair Technician Proficiency

Proficiency = Actual Hours Spent on Repairs / Chilton Standard Hours



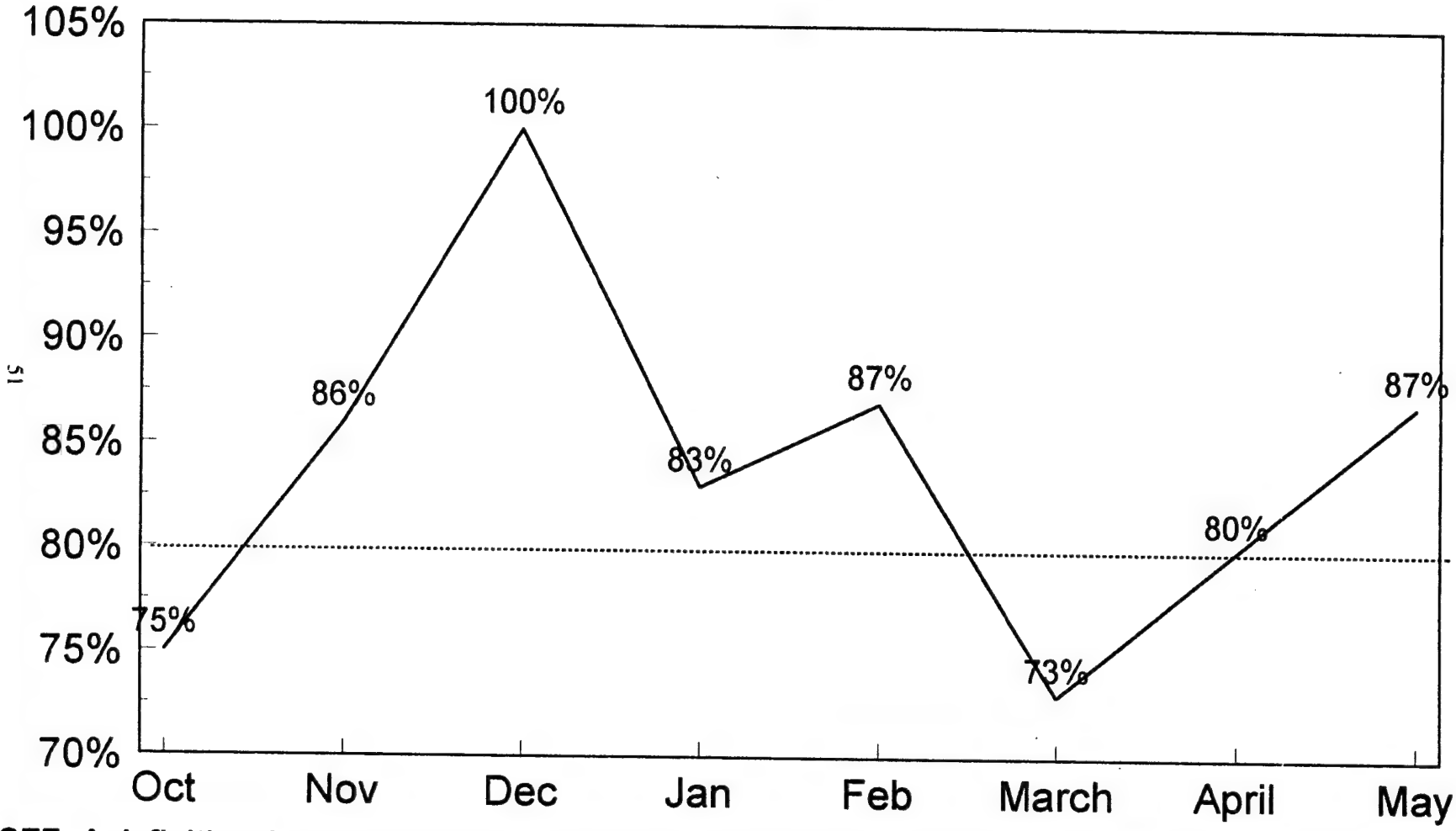
Vehicle Repair Backlog



APPENDIX C

Repair Technician Productivity

Productivity = Actual Hours Spent on Repairs / Hours Available for Work



NOTE: A definitional change occurred in March, whereby time spent in meetings, training, etc. could not be excluded from time available for repair work, resulting in a lower productivity rate as compared to prior months. The switch to two week timecards eliminated the detail on time spent in meetings, education, etc. This problem will be examined in greater detail prior to next month's report.

MOTOR POOL MOEs -May 1996

Vehicle Repairs

Volume of Work:

# vehicles repaired	313
# vehicles provided PM service	125
# vehicles sublet (subcontracted)	57
# safety inspections completed	97
YTD - 413, IFAS - 31	

Backlog:

# vehicles in lot waiting for service, monthly average	5.8
# days customer must wait for an appointment, monthly average	3.5

MOTOR POOL MOEs - May 1996

Vehicle Repairs (continued)

Mechanic Productivity:

# hours available for work	708.25
# hours billed (standard)	699.20
# hours worked (actual)	615.10
actual / standard	88%
standard / available	99%
actual / available	87%

Quality of Work:

# vehicles serviced more than once for the same problem in the last 6 months	0
# quality checks completed	4

PHYSICAL PLANT'S ELECTRIC PICKUP TRUCK #214 - SUMMARY

IN SERVICE FOR PHYSICAL PLANT - April, 1993 to January, 1996.

BUILDERS - 1985 Chevrolet S-10 pickup truck converted to battery electric power in 1993 by Solar Car Corp. of Melbourne, Florida

COST - $19,525 including batteries and charger

OPERATING AND MAINTENANCE COST PER MILE OF OPERATION: ENERGY = 3.4 cents, REPAIR = 20 cents, BATTERIES (prorated) = 12.6 cents.
TOTAL OPERATING AND MAINTENANCE COST = 36 cents per mile. (Comparable O & M cost for gasoline vehicles = 18 cents per mile.)

HORSEPOWER - 28 h.p.

MAXIMUM SPEED - 70 mph

RANGE - 50 to 75 miles per charge depending on type of driving

RECHARGING TIME - 2 to 8 hours

BATTERIES - 20 six volt golf-cart type batteries power the motor plus 1 twelve volt battery to run accessories

ELECTRIC VEHICLE OPERATING AND MAINTENANCE COST COMPARISON SUMMARY

Two year cost comparison from April 1, 1993 to April 1, 1995.

Note that the costs shown below for electric vehicle #214 do NOT include the cost of battery replacement, nor do they reflect the cost of replacing the controller, both of which became necessary shortly after the conclusion of the study.

Also, note that acquisition costs for the vehicles are also NOT included.

VEHICLE	MILES DRIVEN	COST PER MILE: ENERGY	REPAIRS	TOTAL
FIRST YEAR OF OPERATION				
214 ELECTRIC TRUCK	2,303	$.034	$.201	23 cents
GAS - (average of 3)	3,382	$.043	$.171	21 cents
SECOND YEAR OF OPERATION				
214 ELECTRIC TRUCK	2,432	$.034	$.199	23 cents
GAS - (average of 3)	3,609	$.044	$.103	15 cents
TOTAL FOR TWO YEARS				
214 ELECTRIC TRUCK	4,735	$.034	$.200	23 cents
GAS - (average of 3)	6,991	$.044	$.135	18 cents

REFERENCES

1. International City Management Association, Management of Local Public Works, ed. Sam M. Cristofano and William S. Foster, International City Management Association, Washington, 1986

2. Taylor, Arthur W., "Strategic Fleet Management", Public Works Journal, May 1995, p. 44-45

3. Cavanaugh, H.A., "Fueled by Competition, Fleet Managers Steer Over Non-Traditional Roads", Electrical World, August 1994, p. 49-50

4. Carter, Floyd G., "Partial Privatization In A Small City Fleet", Public Works Journal, November 1991, p. 38-39

5. Sitnek, Greg, "How to be Competitive in Fleet Management", Public Works Journal, June 1996, p. 51-52

6. Williams, Arthur, "The Greening of Local Fleets", American City and County, January 1994, p. 22-30

7. Gorski, Brenda, "Start Your (Alternative Fuel) Engines", American City and County, September 1993, p. 72-84

8. Candler, Julie, "Fleet Management for the 90's", Nation's Business, May 1992, p. 33-40

9. Anselmi, Jim and Duncan Frissell, "Specification and Purchase of Specialty Vehicles", Public Works Journal, November 1990, p. 40-41

10. Public Works Manual 1989, "Heavy equipment and Automotive", Public Works Journal, April 1989, p. A-6 to A-8

11. Taylor, Arthur W., "Planning For Equipment Replacement on the Local Level", Public Works Journal", March 1993, p. 65-66

12. American Public Works Association, Public Works Equipment Management, Committee on Equipment, American Public Works Association, Chicago, 1970

13. Wolf, George E. and Robert G. Baker, "From Truck Manufacturing Plant To Municipal Service Center", Public Works Journal, November 1989, p. 50-51

14. Rodie, Edwards B., "NCDOT Equipment Division: Runs Like A Business", Public Works Journal, March 1996, p. 57-58

15. Antonnacci, Frank, "Computerized Management Keeps Fleet in Check", American City and County, September 1994, p. 64-72

16. Public Works Manual 1996, "Fleet Management and Maintenance", Public Works Journal, April 1996, p. A-36 - A-41

17. Mechan, Dennis, "Fleet Maintenance-A Consultant's Perspective", Public Works Journal, November 1991, p. 70

18. Brandon, Roy O., "Solving the Mystery of Successfully Implementing a Computerized Maintenance Management System", Public Works Journal, August 1994, p. 36-38